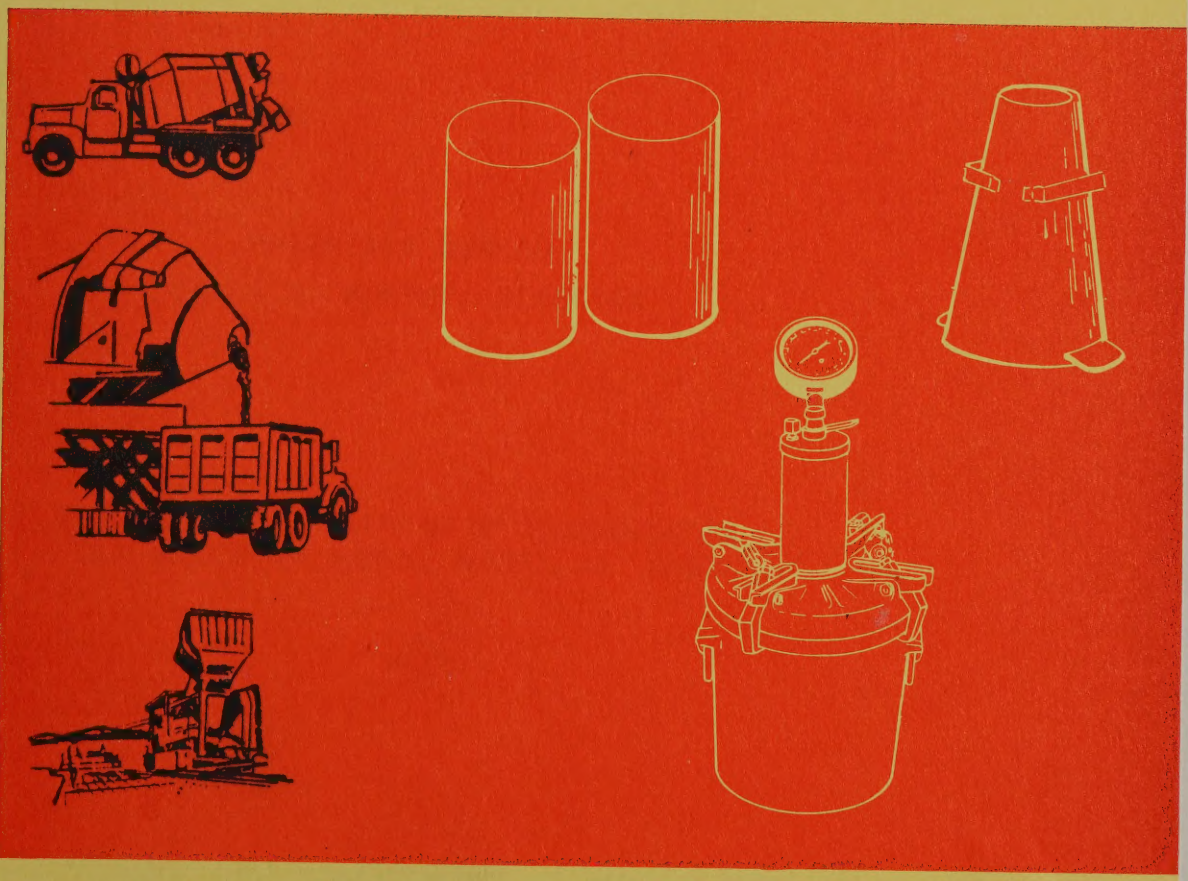
MATERIALS METHOD 9.2

FIELD INSPECTION OF PORTLAND CEMENT CONCRETE



NEW YORK STATE DEPARTMENT OF TRANSPORTATION
MATERIALS BUREAU

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MATERIALS METHOD 9.2

FIELD INSPECTION OF PORTLAND CEMENT CONCRETE

January 1985

MATERIALS BUREAU
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I. SCOPE

This method describes specific procedures for inspecting, sampling and testing portland cement concrete to be used on Department projects to insure conformance with Specifications. The instructions contained herein pertain to the project level inspection phase for concrete.

Instructions for mix design are contained in the companion Materials Method 9.0 entitled, "Proportioning of Portland Cement Concrete." Instructions for plant, mixer and delivery unit approval and plant inspection and testing, are contained in the companion Materials Method 9.1 entitled, "Plant Inspection of Portland Cement Concrete."

This method and the companion methods referenced above supersede all previous instructions for concrete inspection activities.

II. GENERAL

Portland cement concrete for use on Department projects is batched in approved plants under the inspection of resident Plant Inspectors assigned by the Regional Materials Engineer or his representative. Concrete is batched to conform with Mix Designs prepared by the Department and all materials used are approved prior to their use.

Concrete is delivered to the project and point of deposition in approved mixing or haul units. The following describes the concrete mixing and delivery systems normally used on Department projects:

1. Truck Mixed Concrete

   This is defined as concrete mixed on the project in a truck mixer. The cement, aggregates and admixtures are batched at a concrete plant and hauled to the job in a truck mixer. Water addition is from a tank on the truck mixer and all mixing is accomplished on the job. Allowable haul time varies depending upon the method of batching employed at the plant.

2. Transit Mixed Concrete

   This is defined as concrete mixed at the plant or enroute (in transit) to the project in a truck mixer. The cement, aggregates, admixtures and the water are batched at the concrete plant and mixing commences shortly after batching. Some additional water introduction may be required at the job site in order to achieve the proper consistency (slump).

3. Central Mixed Concrete

   This is defined as concrete mixed completely in a stationary mixer at the concrete plant. The mixed concrete is hauled to the job in either truck mixers or open haul units. When truck mixers are used, the drum revolves at agitating speeds while enroute to the project. Certain types of open haul units have agitating blades which also revolve while the unit is enroute to the job. Haul time varies with the type of haul equipment utilized.

4. Mobile Concrete Mixing Unit Mixed Concrete

(For calibration of mobile mixers, high density concrete bridge deck overlays, and latex modified concrete bridge deck overlays, see Materials Methods 9.4, 9.5, and 9.6).

This is defined as concrete mixed completely in a mobile concrete mixing unit on the project. The cement, aggregates, admixtures and water are stored in separate compartments on the mixing unit and are batched (mixed) at the discharge chute. Satisfactory calibration (proportioning) of the different ingredients must be demonstrated before the actual pour.

Project personnel inspect concrete work by checking construction operations and sampling and testing the plastic concrete. Concrete is accepted at the point of deposition on a batch or load basis based on results of tests, visual observations and conformance with the various requirements of specified construction procedures.

The Contractor is responsible for maintaining his concrete supply uniformly within the requirements of the Specification. Project Inspectors are responsible for following the inspection program prescribed in this method. These procedures are designed to give maximum assurance that a quality product will result and will perform well throughout its design life.

III. CONCRETE SPECIFICATIONS, REQUIREMENTS AND CRITERIA

A. General

The Specifications, requirements and criteria for concrete vary depending upon the nature of the work. An Inspector, in order to be effective, must be aware of all the pertinent criteria that affect the work. This section makes reference to the various sources of information that must be consulted by the Inspector.

B. Information Sources

1. Payment Items (In Specifications Book) - Description of work, Materials required, Construction Details, Method of Measurement and Basis of Payment.

2. General Specifications for Portland Cement Concrete (In Specifications Book) - General requirements, Composition of Concrete, Materials and Proportions. Proportioning, Batching, Mixing Equipment and Procedures. Slump and Air Requirements. Construction Procedures for structural and pavement concrete.

3. Plant Plans and Proposal - Plans and location for work. Modifications to Pay Items and General Specifications. Special requirements.

4. Materials Methods (This Manual) - Sampling and testing requirements and procedures.

5. Manual for Uniform Record Keeping (MURK) - Documentation requirements.

IV. INSPECTION CHECKLISTS

The following abbreviated checklist is presented as a guide to the field inspector as information he should possess prior to inspecting a given concrete operation:

1. Equipment and Construction Procedures -

   See Tables 9.2-1A & 9.2-1B for detailed check lists.

2. Concrete -

   a. Concrete Class and Item

   b. Slump Requirements

   c. Air Content Requirements

   d. Approximate Water Requirements

   e. Admixture Requirements

3. Sampling and Testing -

   a. Sampling Technique

   b. Sampling Rate

   c. Tests Required

   d. Acceptance and Corrective Action Procedures

4. Documentation -

   a. Delivery Ticket Requirements

   b. Field Forms

TABLE 9.2-1A
CONCRETE OPERATIONS CHECKLIST

ITEMS TO BE CHECKED*	TRUCK MIXED	TRANSIT MIXED	CENTRAL MIXED (Haul In Truck Mixers)	CENTRAL MIXED (Haul In Open Units)
Approved Mixer, Haul Unit**	X	X	X	X
Batch Size	X	X	X	X
Revolution Counter Working Properly	X	X	-	-
Water System Operating Properly	X	X	X	-
Haul Time	X	X	X	X
Mixing Time	X	-	-	-
Mixing Drum Speed	X	X	-	-
Agitating Drum	X	X	X	-
Number Mixing Revolutions	X	X	-	-
Proper Mixing after Water Additions	X	X	X	-
Discharge Time	X	X	-	-
Discharge Procedure	X	X	-	-
Delivery Ticket	X	X	X	X

*Due to practical consideration, it is not possible to check each delivery vehicle for all items listed. The requirements for concrete documentation, which are contained in MURK, will govern the minimum frequency for checking items such as time and mixing revolutions.

**Department identification labels or tags placed on delivery/mixing units are used to signify approval.

TABLE 9.2-1B
CONCRETE OPERATIONS CHECK LIST

Items to be Checked	Mobile-Concrete Mixing Unit Mixed
Mobile-concrete mixing unit clean	X
Aggregates gates set properly	X
Mix-water dial is set correctly	X
Cement-meter-feeder clean	X
Meter register is operating properly	X
Water system is okay	X
Air system is okay	X
Mix conveyor is okay	X
Aggregates okay	X
No wet or dry pockets in aggregates	X
Correct cement	X

V. SAMPLING AND TESTING

A. General

The program of sampling and testing varies with the nature of the concrete operation. The two major types of operations are the placement of: (1) structural concrete; and (2) pavement concrete. The most frequently conducted field tests for the two major categories are the slump and air tests. These two tests comprise the "Control Series." When compressive strength cylinders are cast for structural concrete, slump and air determinations are also made. These three tests comprise the "Cylinder Series."

Cylinders are not normally cast for pavement concrete since compressive strength is checked using cores drilled from the hardened pavement.

Since sampling procedures directly affect the validity of test results, it is extremely important that the sampling procedures in APPENDIX A be strictly adhered to.

B. Routine Testing

The plans for the routine sampling and testing of structural and pavement concrete are presented in Tables 9.2-2, 9.2-3 and 9.2-4. Table 9.2-2 should be consulted to determine the appropriate test series required for the type of work to be inspected. Table 9.2-3 prescribes the sampling and testing rates to be followed for structural concrete. Table 9.2-4 prescribes the sampling and testing rates to be followed for pavement concrete.

C. Special Testing

1. Yield Tests

There are no prescribed requirements for yield tests. It is recommended that they be conducted only when problems arise concerning yield.

Regional Materials Engineers have all the equipment necessary to conduct yield tests. See APPENDIX F for detailed procedures.

2. Uniformity Tests

There are no prescribed requirements for uniformity tests except in instances where they are required in the Specifications.

In Specifications such as haul units and conveyance systems where uniformity requirements are included, the tests shall be conducted only when deemed necessary by the Engineer. If the routine testing activities or visual observations indicate non-uniform concrete production, then the Engineer should have uniformity tests conducted. An abbreviated uniformity test consisting of a series of slump and air tests on "front" and "back" samples may be substituted for the complete test series at the option of the Engineer. See APPENDIX H for the detailed procedures.

TABLE 9.2-2
CONCRETE TESTING REQUIREMENTS

TYPE	CONTROL SERIES Slump/Air	CYLINDER SERIES* Slump/Air/Cylinders
STRUCTURAL CONCRETE		
Footings	X	X
Pedestals	X	X
Walls	X	X
Piers	X	X
Bridge Sidewalks	X	X
Deck Slabs	X	X
Box Culverts	X	X
Rigid Frames, Arches	X	X
Tremie	X	X
Sign Foundations	X	X**
Lighting Structure Foundations	X	-
Curbs	X	-
Gutters	X	-
Headwalls	X	-
Sidewalks	X	-
Catch Basins	X	-
Manholes	X	-
Drop Inlets	X	-
Field Inlets	X	-
Prestressed, Precast	X	X
Piles	X	X
Concrete Riprap	X	-
Concrete Median Barrier	X	X
PAVEMENT CONCRETE		
Pavement	X	-
Pavement Foundations	X	-
Concrete Driveways	X	-
Pipe Invert	X	-

* Cylinders may be cast on any type work when the Engineer desires to obtain strength information.

**Cylinders not required on foundations when sign area for ground mounted signs is 40 square feet or less.

TABLE 9.2-3
STRUCTURAL CONCRETE TESTING RATES

TEST SERIES	TESTS*	TESTING RATE
Control Series	Slump and Air	One (1) set of tests from each placement regardless of size and thereafter at a rate of one per 50± cubic yards for the duration of that placement. This rate shall be increased by the Engineer whenever indications of non-acceptable concrete are noticed.
Cylinder Series	Slump, Air and and Cylinders	One (1) set from the initial placement of each class of concrete in each contract and thereafter at a minimum rate of one per 200± cubic yards per class of concrete placed. This rate may be increased by the Regional Director or Materials Bureau.

TABLE 9.2-4
PAVEMENT CONCRETE TESTING RATES

TEST SERIES	TESTS*	TESTING RATE
Control Series	Slump and Air	One (1) set from the initial daily placement and thereafter at a rate of one set per 150 to 200 cubic yards of concrete placed (200 cy is equivalent to approximately 500 feet of 12 feet by 9 inch pavement). This rate shall be increased by the Engineer whenever indications of non-acceptable concrete are noticed.

*See the following Appendices for detailed instructions:

Sampling - Appendix A
Slump - Appendix B
Air Content - Appendix C and D
Cylinders - Appendix E

3. Early Strength Determinations

In those instances where it is desired to obtain concrete strength results at times earlier than the normal 28 day period, arrangements should be made with the Regional Materials Engineer.

VI. ACCEPTANCE PROCEDURES

The Specifications state the acceptance criteria based on the results of the various tests. Batches or loads of concrete may be rejected whenever the results of slumps and air tests exceed specification limits.

Every effort should be made to obtain test results before the concrete is in its final position. In the event that indications of non-acceptable concrete are noted, then subsequent loads or batches should be tested. This is particularly important in the case of air contents, since there is no visual check on air as there is for slump.

The Engineer is responsible for developing his detailed acceptance and corrective action procedures based upon the general instructions in this manual and consistent with job specifications. He shall also communicate the results of any tests outside of specifications to the batch plant as soon as possible as well as any other information which may affect subsequent production.

VII. DOCUMENTATION

The Inspector has the responsibility of documenting certain pertinent aspects of the work. These include the recording of checks on concrete construction operations and the results of field tests. The detailed requirements and instructions are included in the Department's "Manual for Uniform Recording Keeping" (MURK).

APPENDIX A

CONCRETE SAMPLING PROCEDURES

I. SCOPE

This method prescribes the procedures to be followed when sampling fresh concrete for routine field testing. It includes procedures for sampling from revolving drum truck mixers, mobile-concrete mixing units, and open top haul units.

II. EQUIPMENT

The following equipment is required:

1. Container for transporting the sample to the test site.
2. Shovel or scoop for sampling and remixing of the concrete.
3. A clean piece of dampened plywood, other non-absorbent surface or container such as a wheelbarrow for remixing the sample.

III. SAMPLE SIZE

Total sample sizes should be large enough so that no concrete used in one test has to be reused in another test. Approximately one-quarter of the total sample should be excess after tests are conducted.

The following size samples shall be obtained:

TESTS TO BE CONDUCTED	APPROXIMATE TOTAL SAMPLE SIZE
1. CONTROL SERIES	
Slump, Air (pressure method)	3/4 cu. ft.
2. CYLINDER SERIES	
Slump, Air (pressure method), Pair Cylinders	1 1/4 cu. ft.

IV. SAMPLING PROCEDURES

A. Obtaining Sample

Concrete is sampled for routine testing purposes after it is discharged from the mixing or hauling equipment and just prior to any additional manipulation such as spreading, vibration, screeding or finishing. A sample may consist of several portions which are taken from different locations within the batch and mixed together prior to testing or it may consist of only one portion of the batch depending upon the type of tests to be conducted and the type of operation in effect.

Table 9.2 A-1 prescribes the sampling procedures to be employed under various conditions.

When a check is to be made on slump and air (CONTROL SERIES), note that the sample may be obtained from one portion of the batch (usually the initial portion) so the tests may be completed prior to the completion of discharge. It should also be pointed out that whenever cylinders are cast (CYLINDER SERIES), the sample shall be taken from the middle third of the batch. The only exception to this is when you are sampling from a mobile concrete mixing unit, where the sample shall be obtained from the initial portion.

Regardless of the sampling method used, the Inspector should always attempt to obtain concrete which appears to be representative of the entire batch.

B. Remixing Sample

Transport the sample to the place where tests are to be performed and remix the sample with shovel or scoop to insure uniformity. The remixing shall be accomplished in a wheelbarrow, or on a non-absorptive surface such as a piece of metal or a dampened piece of plywood that is large enough to prevent loss or contamination of the material. The sample shall be protected from sunshine and wind as much as possible during the period in which it is obtained and used for testing, which shall not exceed 15 minutes.

When the sample is obtained from a mobile concrete mixing unit the air pot should be filled, and the cylinders fabricated within 3 minutes. The slump test must be delayed 3 to 5 minutes after sampling.

TABLE 9.2A-1
CONCRETE SAMPLING PROCEDURES

MIXING/HAULING EQUIPMENT	TEST SERIES*	SAMPLING PROCEDURES
1. Revolving Drum Truck Mixers	Control (Slump, Air)	a. Obtain samples from 1 or more portions of the batch.
		b. Samples shall not be taken at the very beginning or end of discharge (Approx. first or last 10% of discharge). Sampling shall be done by repeatedly passing a receptacle through the entire discharge stream, or by diverting the stream completely so that it discharges into a container.
	Cylinder (Slump, Cylinder)	c. Obtain sample from the middle Air, third of the batch.
2. Mobile Concrete Mixing Units	Control (Slump, Air)	a. Obtain samples from the initial portion of the load.
		b. Samples shall not be taken from the first 1 or 2 cubic feet of the load. Sampling shall be done by diverting the stream so that it discharges into a container. The air pot should be filled, consolidated and struck off within three (3) minutes of sampling. The slump test must be delayed (3) to five (5) minutes after sampling.
	Cylinder (Slump,	c. Same as 2 a. above. Air, Cylinders)
		d. Same as 2 b. above. The cylinders should be fabricated within three (3) minutes of sampling.
3. Open Top Haul Units	Control (Slump, Air)	a. Same as 1 a. above.
		b. The sample may be obtained on the grade, before or after the spreading operation.

*SEE TABLES 9.2-3 and 9.2-4

APPENDIX B

SLUMP TEST PROCEDURE

I. SCOPE

This test method prescribes the procedure for determining the slump of concrete.

II. GENERAL

The slump test is a test used to measure the consistency or stiffness of fresh (plastic) concrete. The test is conducted by placing a sample of concrete into a mold (slump cone) in a prescribed manner, removing the mold and then measuring the distance the unsupported concrete settles or slumps. This test is an indirect measure of the amount of water within a mix. The amount of water must be controlled since for a given mix design large increases in water content will lower strength, durability and will cause the mix to segregate.

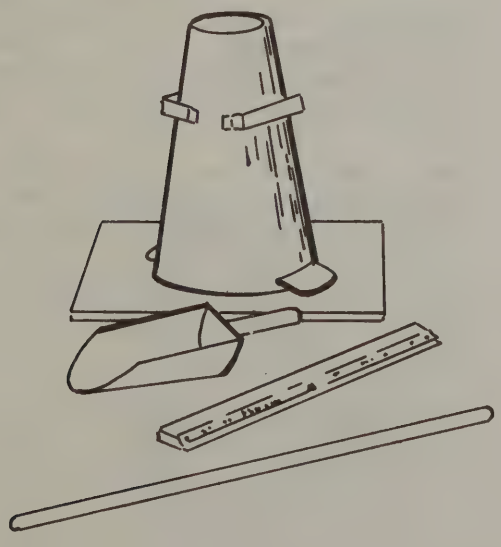
III. SAMPLE

The sample of concrete shall be obtained in accordance with Appendix A, "CONCRETE SAMPLING PROCEDURES."

When the concrete is mixed by a mobile-concrete mixing unit the sample must sit from 3 to 5 minutes before running the slump test.

IV. EQUIPMENT

The following equipment is required for the slump test:



1. Standard slump cone as defined in ASTM Designation C-143.

2. A round, straight steel rod, 5/8" in diameter, 24" in length, with a hemispherical tip.

3. A moist, non-absorbent, level surface firmly supported.

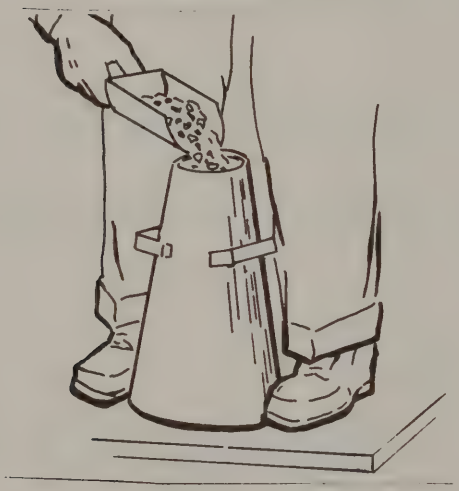
4. A scoop and ruler.

V. TEST PROCEDURE

1. Dampen inside of slump cone with water.

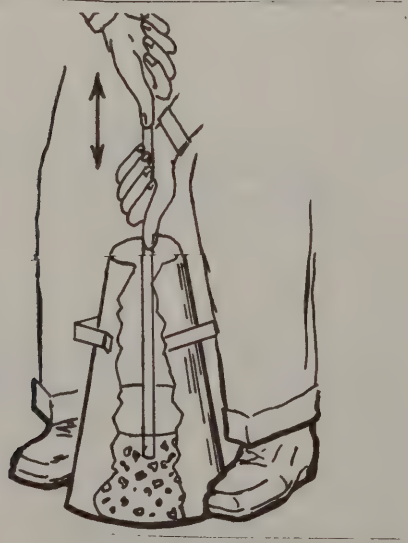
   Place slump cone on a level, moist non-absorbent surface that is firmly supported and free from vibrations.

   The cone shall be held firmly in place by the Inspector standing on the 2 foot pieces. It is imperative that the Inspector not remove his weight from the foot pieces at any time during the filling of the cone.



2. The cone is to be filled and rodded in three (3) layers; each layer equal to one-third of the volume of the slump cone.

   NOTE: One-third of the volume of slump cone fills it to a depth of about 2½"; two-thirds of the volume fills it to a depth of about 6".



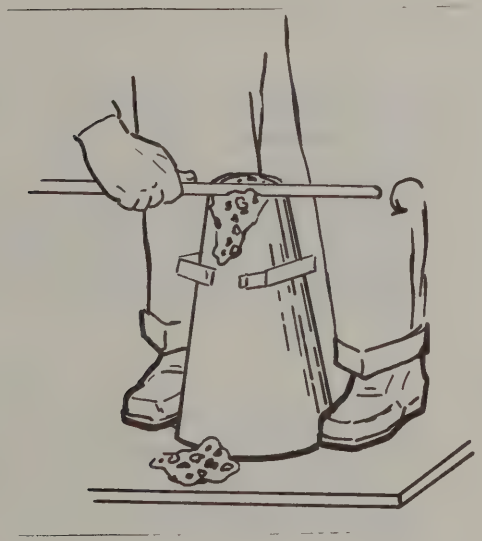
3. Rod each layer with 25 strokes of the tamping rod, uniformly distributing the strokes over the cross-section of each layer.

   For the bottom layer this will necessitate inclining the rod slightly and making approximately half of the strokes near the perimeter and then progressing with vertical strokes spirally toward the center.

   Rod the bottom layer throughout its depth.

4. Rod the second layer and the third layer each throughout its depth, just penetrating into the underlying layer.

   When filling the top layer, heap the concrete above the cone before rodding is started. While rodding the top layer, add additional concrete when necessary, to keep an excess of concrete above the top of the cone at all times.

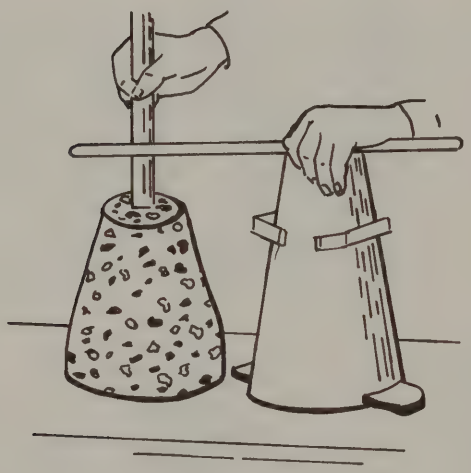


5. After the top layer has been rodded, strike off the concrete by means of a screeding and rolling motion of the tamping rod, being certain that no further tamping or compaction of the material occurs.

   Clear away any spilled concrete from the base of the slump cone.

6. Pressing down firmly on the slump cone handles, remove feet from the foot pieces.

7. Raise the slump cone vertically with a steady upward lift, taking approximately 5 seconds. No lateral or torsional motion shall be imparted to the concrete.



8. Immediately measure the slump to the nearest ¼" by determining the difference between the height of the slump cone and the height over the original center of the base of the specimen. Record the results on the appropriate MURK form.

   NOTE: If a decided falling away or shearing off of concrete from one side or portion of the mass occurs, disregard the test and make a new test on another portion of the sample.

-- CLEAN YOUR EQUIPMENT --

APPENDIX C

AIR CONTENT TEST PROCEDURE - PRESSURE METHOD

I. SCOPE

This test method prescribes the procedure for determining the air content of freshly mixed concrete using the Washington-type pressure air meter.

II. GENERAL

The air content test is used to measure the volume of air bubbles within a sample of plastic concrete.

Air bubbles of microscopic size are intentionally put into concrete to provide resistance to the effects of freezing and thawing on hardened concrete, to increase durability, to reduce the requirements for water in the mix, to improve the workability and finishing properties and to reduce segregation of the plastic concrete. Concrete with air contents lower than specified will not be durable. Concrete with excessively high air contents will have both lower strength and lower durability.

The pressure method described herein determines the air content of freshly mixed concrete by allowing a known volume of air at a certain initial pressure to expand into a container filled with fresh concrete thereby compressing the entrained air. The amount of air in the concrete is proportional to the decrease in pressure and may be read directly from a gage as percent air.

III. SAMPLE

The sample of concrete shall be obtained and remixed in accordance with Appendix A "CONCRETE SAMPLING PROCEDURES."

When the sample is obtained from a mobile concrete mixing unit the air pot should be filled, consolidated and struck off within three (3) minutes of sampling.

IV. EQUIPMENT

A. Description

The equipment described below is a Washington-type air meter manufactured by the Concrete Specialties Company. It is in general use by the Department and is called the Press-Ur-Meter. There are numerous other designs of pressure type air meters and any meeting the requirements of ASTM Designation C-231 are acceptable.

The meter consists of the following components:

1. Base Container - A flanged cylindrical metal container sufficiently rigid to limit its expansion. The upper surface of the container is machined smooth where it fits the cover so as to be pressure tight. The container has a volume of 0.25 cu. ft.

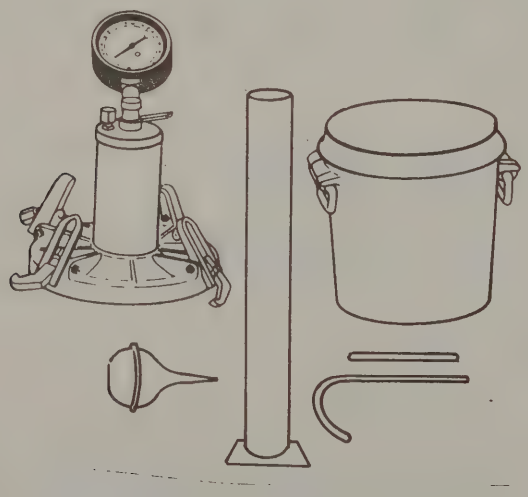
2. Cover Assembly - A metal cover assembly, the rim of which is gasketed to provide a pressure tight fit with the base container when the two are clamped together. The cover assembly includes an air chamber, a pump for developing pressure in the air chamber, a valve for bleeding the air chamber to atmospheric pressure, an operating valve for allowing air in the air chamber to enter the base container, petcocks which will release air in the container directly to the atmosphere, and a pressure gage with a suitable range and calibrated to read directly the percent of air.

3. Calibration Vessel - A cylindrical measure having a known volume which is used to calibrate the meter.

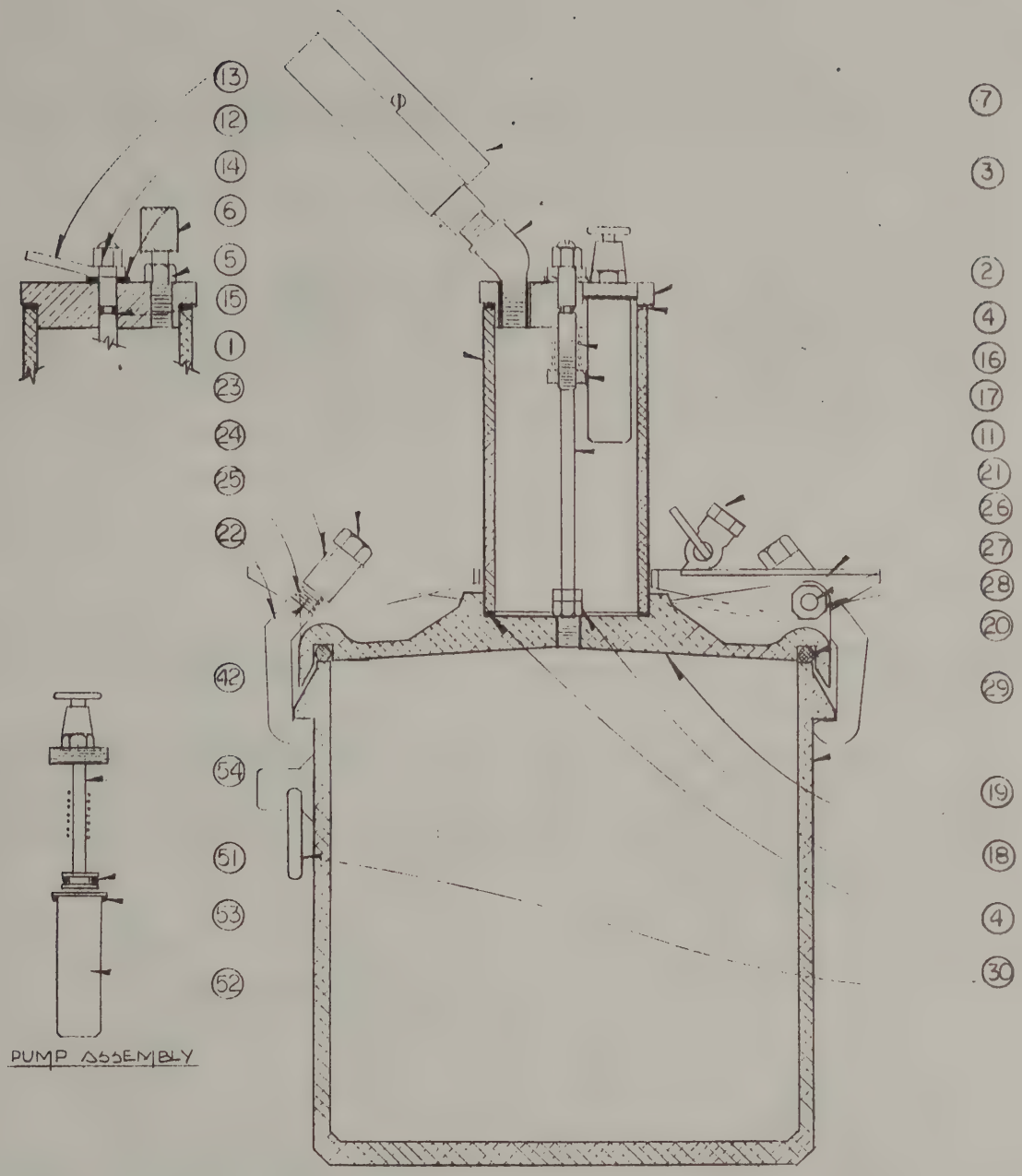
4. Calibration Tubes - A straight piece and a curved piece of tubing, threaded at one end which are utilized in the calibration of the meter.

5. Miscellaneous Equipment - Scoop, rubber syringe, mallet, strike-off bar, and a steel tamping rod of 5/8-inch diameter with hemispherical tip and at least 12-inches in length.

Air meter and equipment necessary to perform an air test.



Air meter and equipment necessary to calibrate the meter.



PUMP ASSEMBLY

PART NO.	
1.	PRESSURE CHAMBER
2.	PRESSURE CHAMBER CAP
3.	PRESSURE CHAMBER ELBOW
4.	PRESSURE CHAMBER GASKET
5.	PRESSURE CHAMBER AIR RELEASE STEM
6.	PRESSURE CHAMBER AIR RELEASE CAP
*6A.	RELEASE CAP
7.	COMPLETE GAUGE
11.	NEEDLE VALVE STEM
12.	NEEDLE VALVE NUT
13.	NEEDLE VALVE LEVER
14.	NEEDLE VALVE SPACER
15.	NEEDLE VALVE "O" RING
16.	NEEDLE VALVE SPRING
17.	NEEDLE VALVE SPRING RETAINER
18.	NEEDLE VALVE SEAT ASSEMBLY
19.	COVER
20.	COVER "O" RING
21.	COVER PET COCK
22.	CLAMP
23.	CLAMP NUT

PART NO.	
24.	CLAMP TRUNION
25.	CLAMP SPRING
26.	CLAMP TOGGLE
27.	TOGGLE SET SCREW
28.	TOGGLE LOCK NUT
29.	BASE
30.	BASE HANDLE
*31.	CALIBRATING VESSEL
*32.	CALIBRATING TUBE (OUTER)
*33.	CALIBRATING TUBE (INNER)
*34.	STRIKE OFF BAR
*35.	TAMPING ROD
36.	SYRINGE
*37.	GAUGE GLASS
*38.	CARRYING CASE
42.	CLAMP STUD
*50.	PUMP PISTON
51.	REPLACEMENT "O" RING
52.	PUMP TUBE ASSEMBLY
53.	REPLACEMENT "O" RING
54.	PUMP PISTON ASSEMBLY

*NOT ILLUSTRATED

B. Maintenance and Repair

It is essential that the air meter is cleaned thoroughly after each use, making sure that all valve orifices are clean.

The air meter should be transported in its case to protect it from damage.

Minor repairs such as replacements of gaskets, petcocks, gages, etc., should be accomplished by Regional personnel. Replacement parts for the air meter are available from the Regional Materials Engineer. Included in this method is a drawing of the meter and a replacement parts list. When requesting parts, include the part number and part name. Major repairs, when necessary, will be accomplished by the Materials Bureau, Albany.

V. CALIBRATION

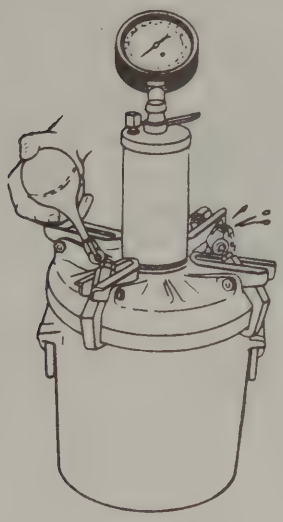
A. General

The calibration procedure described below is for the Press-Ur-Meter. Other designs should be calibrated by following the instructions supplied by the manufacturer.

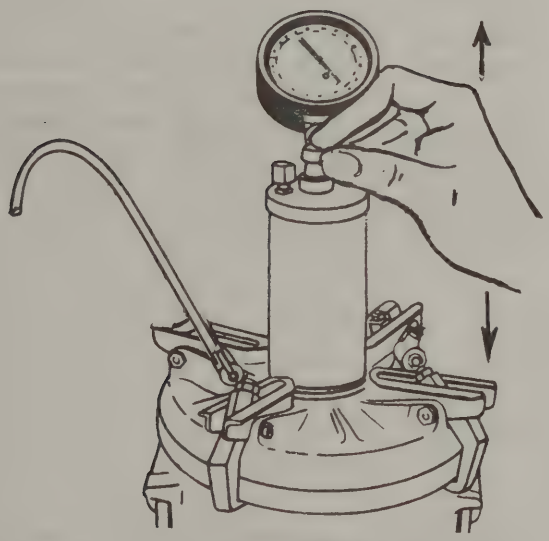
The calibration of the air meter involves filling the meter with water and then removing known volumes of water and adjusting the meter to read corresponding percentages of air. The air meter should be calibrated when it is initially received on the project and periodically throughout the construction season.

B. Procedure

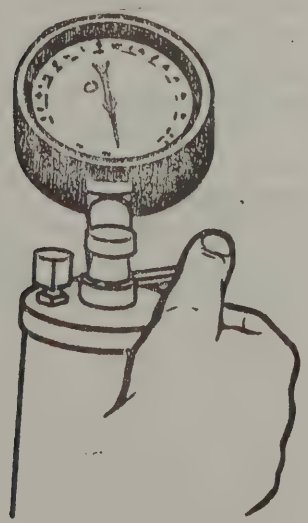
1. Fill the base full of water. Screw the short piece of straight tubing into the threaded petcock hole on the underside of the cover. Clamp cover on the base with tube extending down into the water.



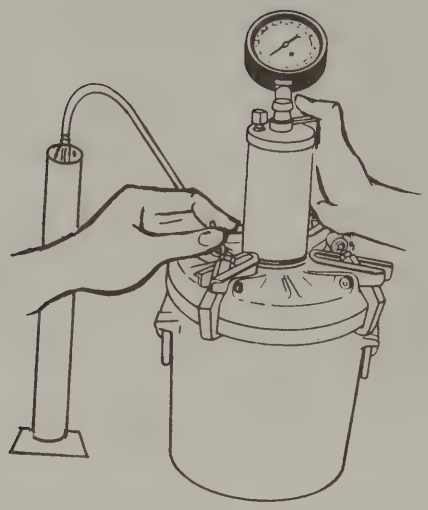
2. With both petcocks open, add water with the syringe through the petcock having the pipe extension below, until all air is forced out opposite petcock. Leave both petcocks open.



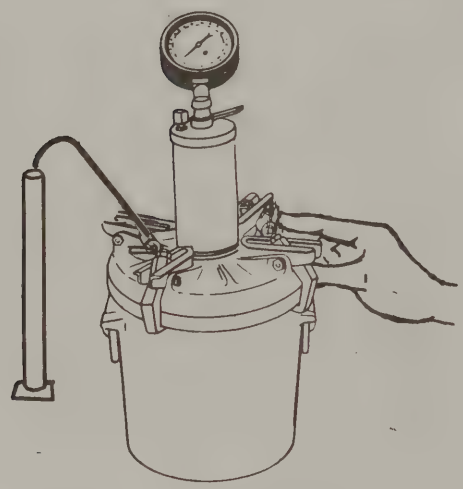
3. Screw the curved tube into the petcock having the pipe extension below. Pump up the air pressure in the upper chamber to a little beyond a selected trial initial pressure line. Allow a few seconds for the compressed air to cool to normal temperature and then bring the gage needle to the selected initial pressure line by bleeding off air and tapping the gage lightly with the fingers. Close both petcocks.



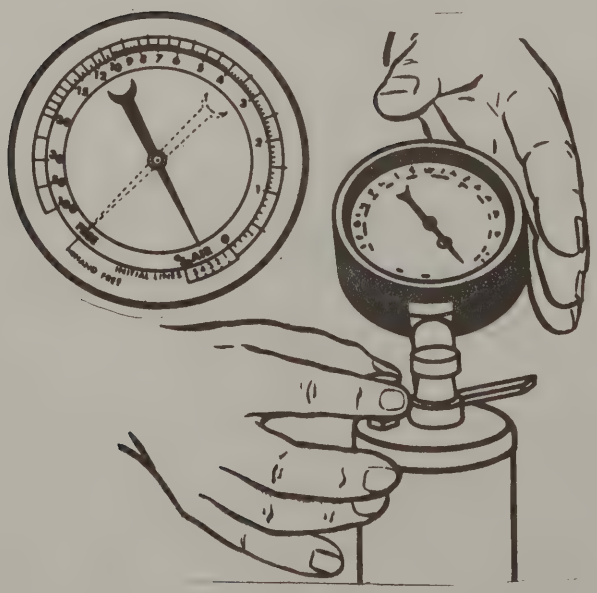
4. Press the thumb lever to release the air into the measuring bowl. Depress again to check that the needle has really stabilized. The gage should read 0.0% ± 0.1%



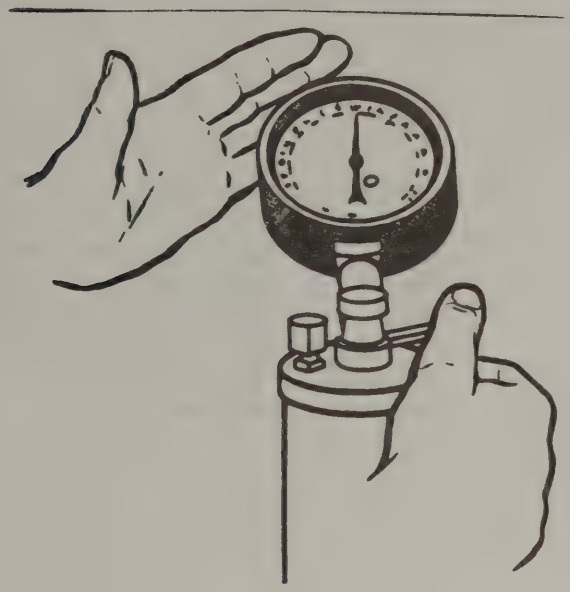
5. By pressing on the thumb lever and controlling the flow with the petcock lever, fill the 5% calibration vessel level full of water.



6. Release the air at the free petcock. Open the other petcock and let the water in the curved pipe run back into the base. There is now a 5% air void in the base.



7. With both petcocks open, pump up the air pressure to a little beyond a selected trial initial pressure line Allow a few seconds for the compressed air to cool to normal temperature and then bring the gage needle to the selected initial pressure line by bleeding off air and tapping the gage lightly with the fingers.



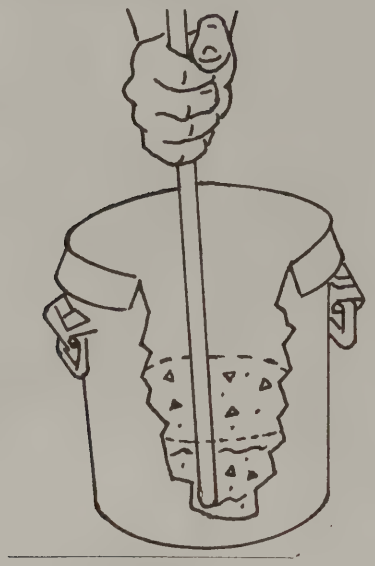
8. Close both petcocks and depress the thumb lever. Holding the thumb lever down, tap the gage lightly with the fingers and allow the needle to stabilize. Release the thumb lever for several seconds and then depress again to check that the needle has really stabilized. The gage should read 5.0% ± 0.1%.

9. If the gage does not register within the desired range, select another initial line and repeat steps 6 and 7. When the gage reads correctly, withdraw additional water in the same manner as before and check results at 10%.

10. If the gage does not register within an estimated ±0.2% of 10%, remove the glass from the pressure gage and set the gage needle to 10% by turning the recalibrating screw located just below and to the right of the gage needle. A recheck should be made on the 5% reading.

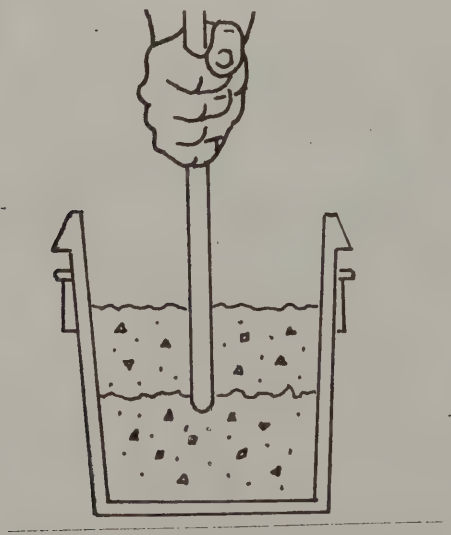
11. When the correct initial line has been determined and the meter is properly calibrated, attach a tag to the meter cover with the date of calibration, proper initial line, and name of person who calibrated the meter.

VI. TEST PROCEDURE

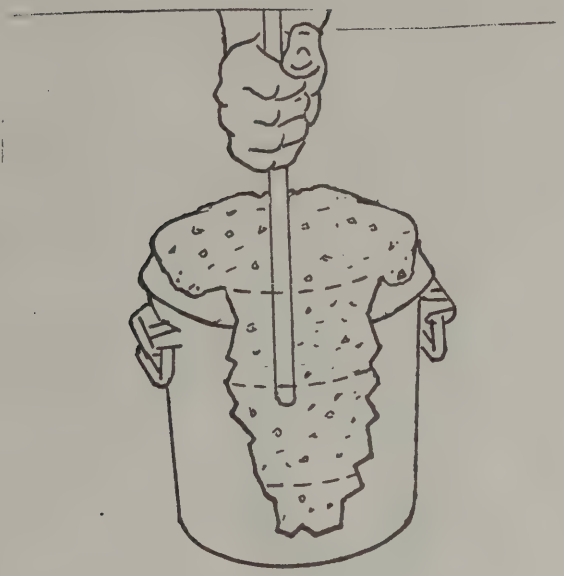


1. Dampen the inside of the base container and then fill it one-third full with concrete been properly sampled and remixed. Rod this layer throughout its depth with 25 strokes of the tamping rod, evenly distributed over the cross-section.

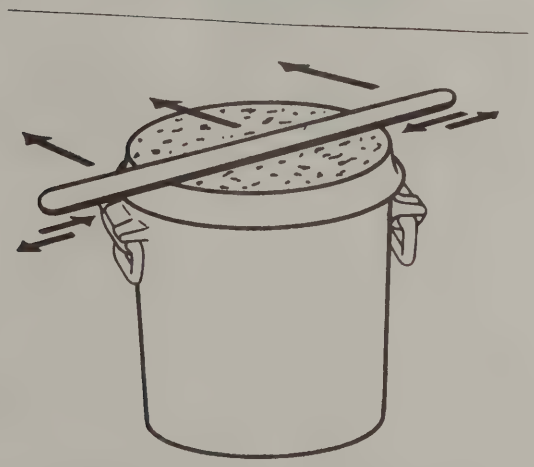
2. After rodding, rap the sides of the container smartly 10 to 15 times with the mallet to close the voids left by the tamping rod.



3. Fill the base container two-thirds full and rod 25 times, evenly distributing the strokes over the cross-section and just penetrating into the layer below. Rap with the mallet as before.



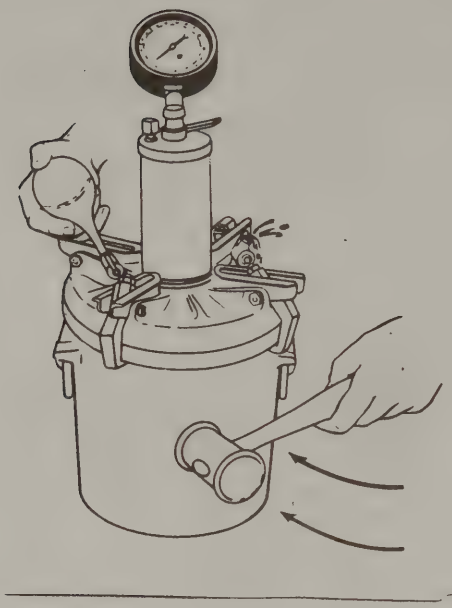
4. Slightly overfill the container when placing the top layer. Rod 25 times and rap with the mallet as before.



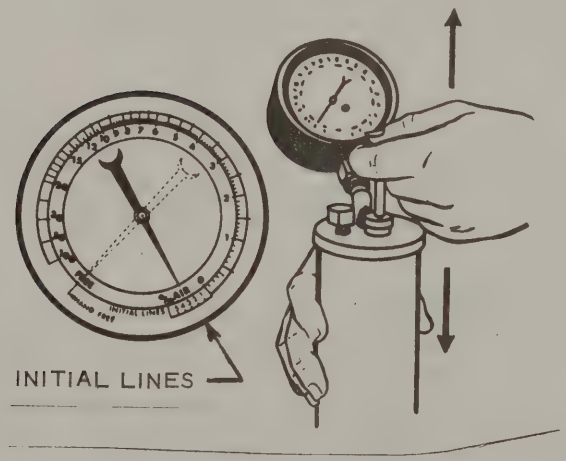
5. Remove the excess concrete by sliding the strike-off bar across the top flange with a sawing motion until the bowl is level full.

   NOTE: Precision in strike-off is not necessary in this case. An error of about 1/8" in strike-off will only induce an error of approximately 0.08% in the air content reading.

6. Wipe the top edge of the base container clean and clamp the cover on with both petcocks open. Clamps opposite each other should be closed simultaneously.



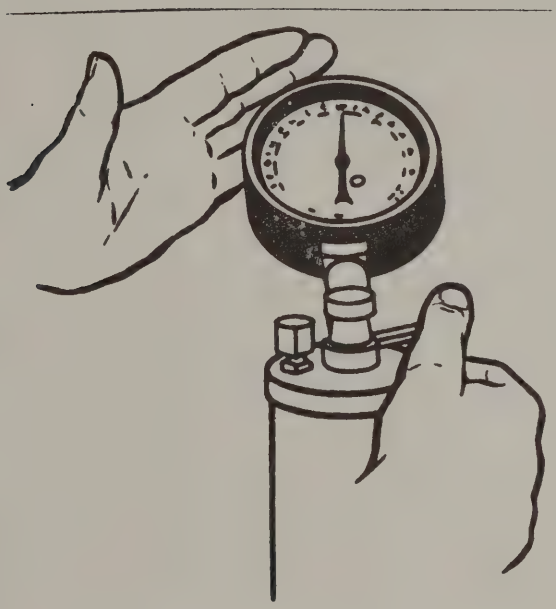
7. Introduce water into the base container through one of the petcocks with the syringe until water flows out the other petcock free of air bubbles. While introducing the water, tap the sides of the container gently with the mallet to insure removal of all air from the top of container.



8. Leaving the petcocks open, pump up the pressure in the air chamber to slightly beyond the proper initial line.

   NOTE: If the initial line is not known, then the meter must be calibrated in accordance with Section V.

9. Allow a few seconds for the compressed air to cool to normal temperature and then bring the gage needle to the proper initial pressure line by bleeding off air and tapping the gage lightly with the fingers.



10. Close both petcocks and depress the thumb lever to release air into the base container. While holding the thumb lever down, tap the sides of the airpot sharply with a mallet and then with the thumb lever still depressed, tap the gage lightly with the fingers and allow the gage needle to stabilize.

    Release the thumb lever and read or estimate the percent of air indicated on the gage to the nearest 0.1%. The test value shall be recorded on an appropriate MURK Form.

Release the pressure in the container by opening the petcocks. Remove the cover and thoroughly clean the equipment.

APPENDIX D

AIR CONTENT TEST PROCEDURE - VOLUMETRIC METHOD

I. SCOPE

This test method prescribes the procedure for determining the air content of freshly mixed concrete by the volumetric method.

II. GENERAL

The air content test is used to measure the volume of air bubbles within a sample of plastic concrete.

Air bubbles of microscopic size are intentionally put into concrete to provide resistance to freezing and thawing of hardened concrete, to increase durability, to reduce the requirements for water in the mix, to improve the workability and finishing properties and to reduce segregation of the plastic concrete. Concrete with air contents lower than specified will not be durable. Concrete with excessively high air contents will have both lower strength and lower durability.

In this test, the air content of the concrete is determined by the use of an apparatus as described in ASTM Designation C-173. Water is used to displace the air bubbles in the concrete and the resulting drop in the water level is observed to determine the air content.

The air content of concrete comprised of lightweight or porous aggregates such as slag must be determined by this method.

III. SAMPLE

The sample of concrete shall be obtained and remixed in accordance with Appendix A "CONCRETE SAMPLING PROCEDURES."

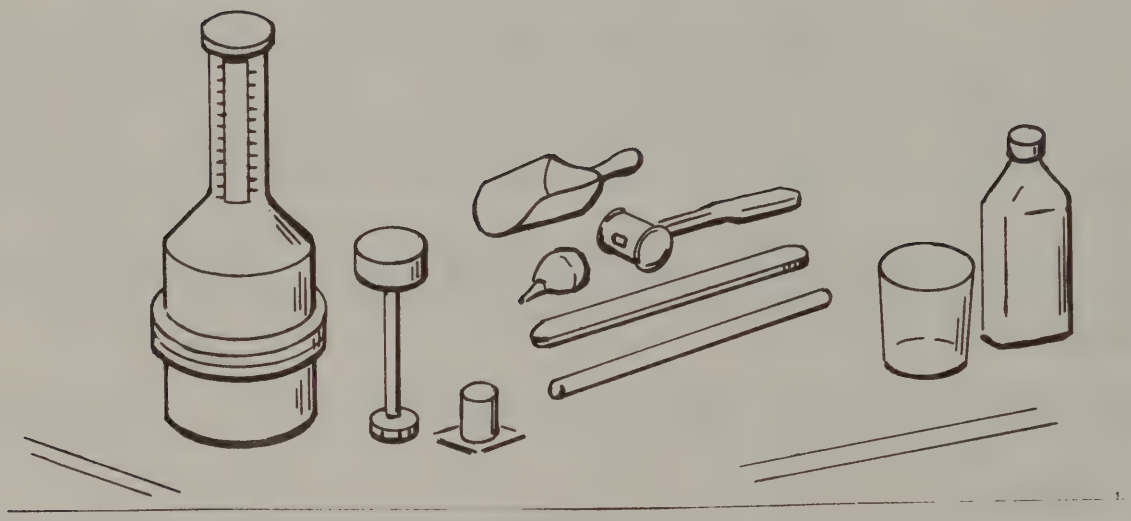
IV. EQUIPMENT

1. Base Container - A cylindrical base container of machined metal sufficiently rigid to withstand field use. The base container is flanged so that it may be clamped to the top section for a watertight fit. The capacity of the container shall be 0.075 of a cubic foot or larger.

2. Top Section - Constructed of machined metal that is flanged and equipped with a gasket and clamping devices so that it may be attached to the base container to make a watertight fit. The top section also includes a neck that is lined with glass that is graduated with a suitable scale so that the percent of air can be read directly. The top of the neck is equipped with a threaded screw cap that is gasketed to provide a watertight fit.

3. Metal Funnel - A special funnel that is long enough to enter the top of the neck and extend to just above the top of the base container. Its discharge end is baffled so as to create minimum disturbance to the concrete when the water is introduced.

4. Miscellaneous Equipment - Including a tamping rod with a hemispherical tip, strike-off bar, rubber syringe, scoop, mallet, bottle of Isopropyl alcohol, pouring vessel and a measuring cup equal to 1.0 percent of the volume of the base container.



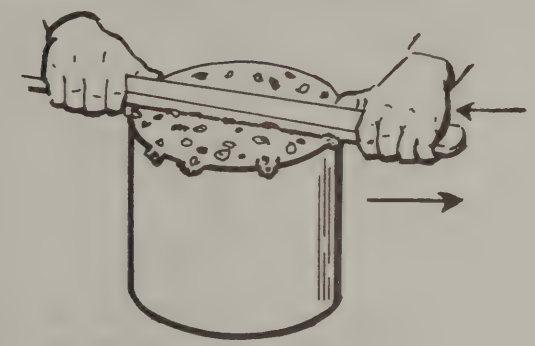
EQUIPMENT

V. CALIBRATION

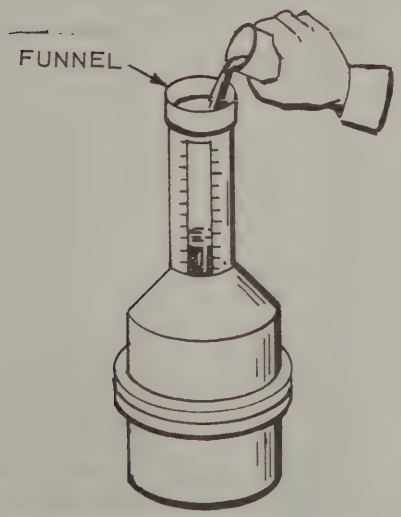
The calibration shall be performed as outlined in ASTM Designation C-173. The Materials Bureau will initially check the apparatus before it is issued to the Region. Since the equipment has no moving parts that may wear or need periodic adjustment, future calibration should not be necessary unless it becomes damaged.

VI. TEST PROCEDURE

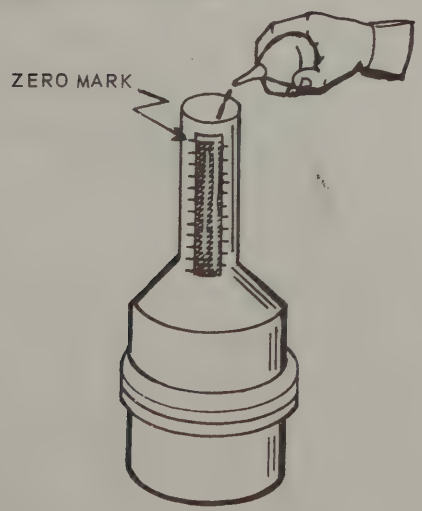
1. Fill the base container with concrete in the same manner prescribed for the pressure air meter (APPENDIX C), i.e. three (3) layers of equal depth, rodding each layer 25 times with the tamping rod and rapping the sides of the bowl 10 to 15 times with the mallet to close the voids.



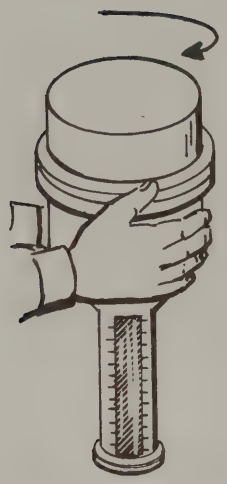
2. After the third layer has been rodded 25 times and the bowl rapped 10 to 15 times with the mallet, remove the excess concrete by sliding the strike-off bar across the top flange with a sawing motion until the bowl is level full.



3. Wipe the flange clean and clamp the top section to the base container. Insert the special funnel and add water until it appears in the neck.

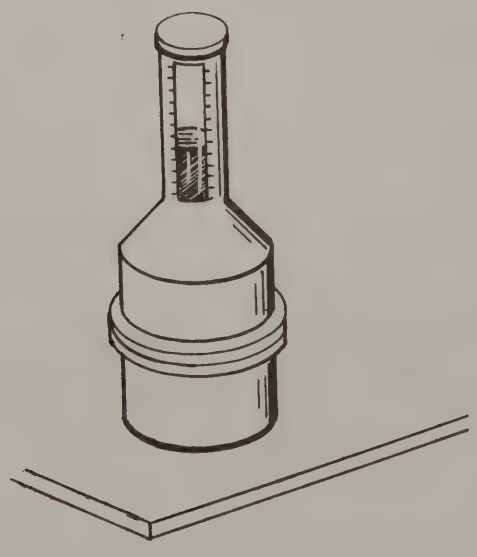


4. Remove the funnel and add water with the syringe until the bottom of the meniscus is level with the zero mark.

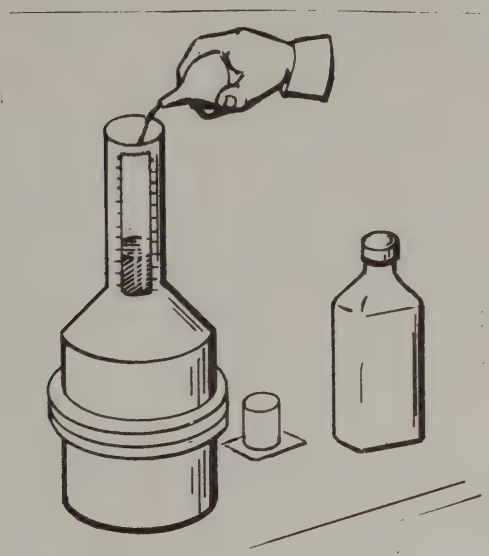


5. Attach and tighten screw cap, invert the unit and agitate until the concrete settles free from the base.

6. With the neck in an elevated position, completely mix the water with concrete by a rolling and rocking motion until the air appears to have been removed from the concrete.



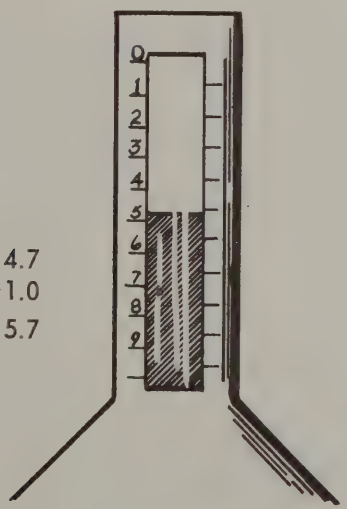
7. Set the unit on its base, jar it lightly, and allow the air to rise to the top. Lightly jar or agitate the unit occasionally until the air bubbles cease rising. Repeat steps 6 and 7 until no further drop in the water column is observed.



8. Remove the screw cap and introduce in one cup increments with the syringe, sufficient isopropyl alcohol to dispel the foam on the surface of the water. Stirring will quickly condense the foam.

9. Read the bottom of the meniscus in the neck (estimating to the near est 0.1%) and then determine the percent of air by adding 1.0% for each cup of isopropyl alcohol (decreased air due to the added alcohol). Record the results on the appropriate MURK form.

Example:
1 cup of
isopropyl
alcohol



Reading 4.7
Alcohol +1.0
% Air 5.7

10. Clean your equipment.

APPENDIX E

CONCRETE CYLINDER - FABRICATION PROCEDURE

I. SCOPE

This test method prescribes procedures for the fabrication and curing of concrete compressive test specimens. Instructions for documentation and shipping are also included.

II. GENERAL

Concrete cylinders are cast so that the compressive strength properties of the mix can be determined. Cylinders are cast in pairs by placing the plastic concrete in molds in a prescribed manner. The specimens are cured on the project in curing boxes for a specified period and then shipped to the Materials Bureau Laboratory for testing. (Regions having equipment to perform the tests may do so on regular cylinders. Record Sampling cylinders must be sent to the Materials Bureau Laboratory.) The compressive strength test consists of measuring the maximum load carried by a cylinder before failure. The compressive strength is calculated by dividing the failure load by the cross-sectional area of the cylinder. This test is normally conducted when the cylinders are 28 days old.

The compressive strength of concrete is considered to be an overall indication of concrete quality. Except in special cases no value of compressive strength is specified for Department work. The results are used by the Department to monitor concrete performance and to check design assumptions. The general mix classes are designed to yield concrete with strengths in excess of 3000 pounds per square inch at 28 days. This is the value normally used as a design assumption in concrete structures. When strengths fluctuate greatly or fall below the design criteria, an investigation is normally conducted to determine if a problem may exist.

III. SAMPLE

The concrete for test specimens shall be sampled and remixed in accordance with Appendix A, "CONCRETE SAMPLING PROCEDURES." Compressive strength samples shall be at least 1¼ cu. ft. and are always taken from the middle third of the batch. The only exception to this is when obtaining a sample from a mobile concrete mixing unit the entire sample shall be taken from the initial portion of the load, after wasting 1 to 2 cubic feet, and the cylinders should be fabricated within three (3) minutes of sampling.

IV. EQUIPMENT

The following equipment is required for the fabrication and curing of concrete compressive test specimens.

1. Molds - Molds for compression test specimens shall be as supplied by the Materials Bureau. They will be cylindrical in shape and have inside dimensions of 6-inches in diameter by 12-inches in height.

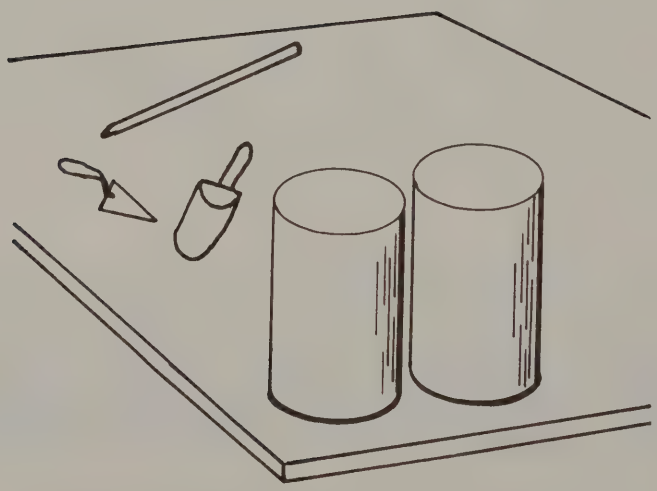
2. Tamping Rod - A round straight steel rod 5/8-inch in diameter and approximately 24-inches in length. The tamping end shall be rounded to a hemispherical tip.

3. Sample Container, scoop and trowel.

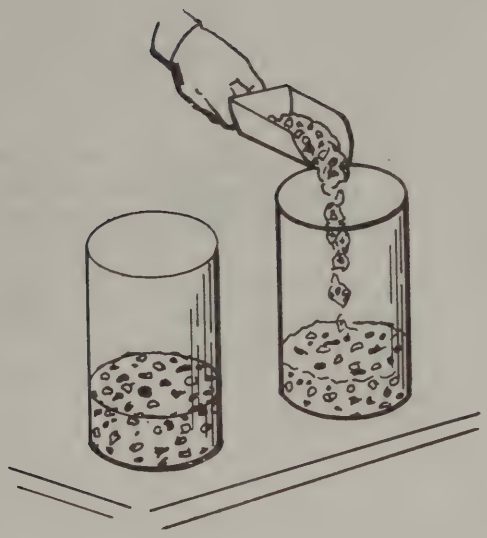
4. Concrete Cylinder Curing Box - A curing box that meets the requirements set forth in the contract specifications.

V. TEST PROCEDURE

1. Perform the slump test in accordance with Appendix B and an air test in accordance with Appendix C or D.

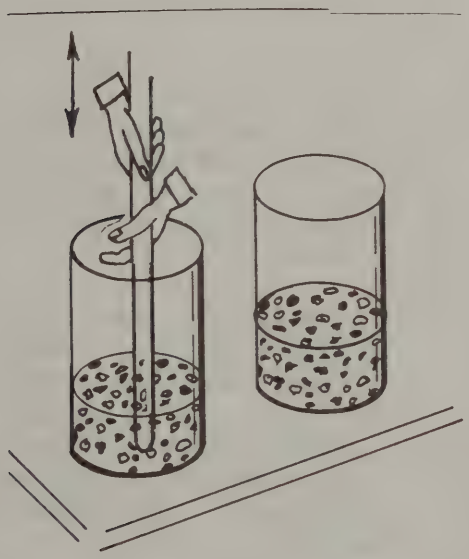


2. Place the cylinder molds on a smooth firmly supported surface, to insure that the bottoms of the molds do not become dented or punctured during rodding.

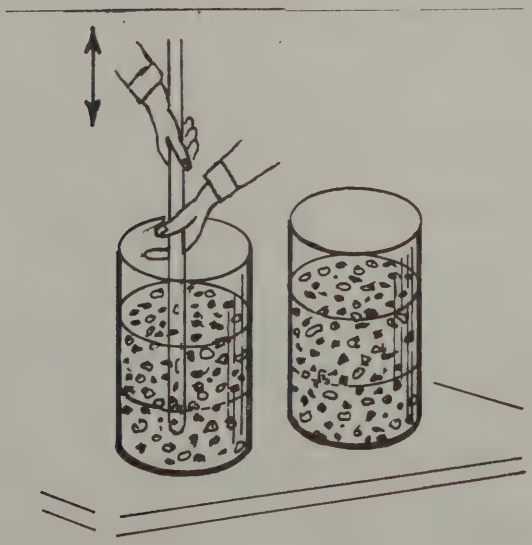


3. Fill the molds in rotation, placing a scoopful of concrete first in one and then in the other, until each mold is 1/3 full. In placing each scoopful of concrete, move the scoop around the top edge of the mold to insure symmetrical distribution of the concrete within the mold. The concrete may be further distributed by use of the tamping rod prior to the start of rodding.

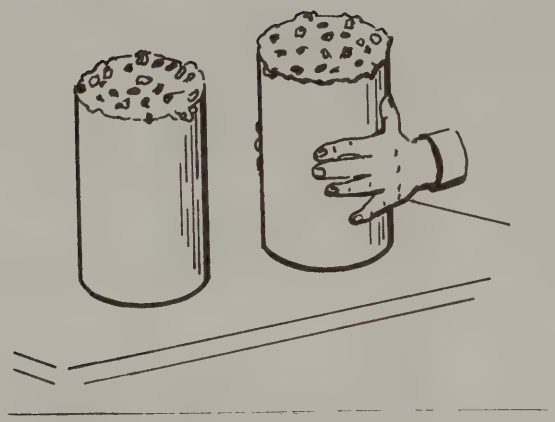
   NOTE: When fabricating test cylinders, any aggregate particles over 2½" in any dimension shall be removed from the mix by hand.



4. Rod the bottom layer throughout its depth 25 times with the tamping rod, evenly distributing the strokes over the cross-section of the mold. After rodding, sides of the mold lightly with the mallet to close any voids.

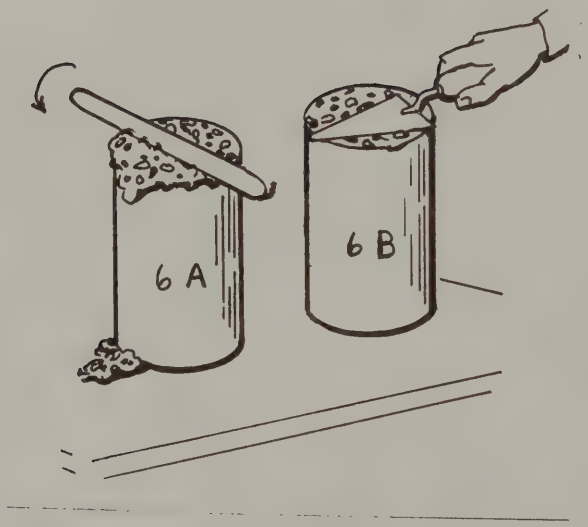


5. Fill the molds in the same manner as Step 3 until each mold is 2/3 full. Rod this second layer with 25 strokes, just penetrating into the layer below (about 1"). Tap the sides with the mallet.



6. Fill the molds to overflowing when placing the top layer and rod 25 times in the prescribed manner.

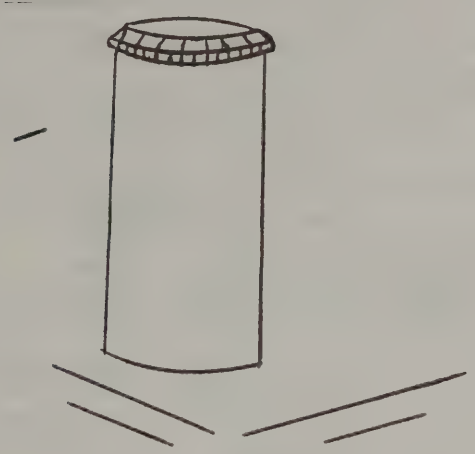
   After rodding of the top layer is completed, tap the sides of the mold with the mallet to close voids left by the rodding operation.



7. Strike off excess concrete with a rolling and screeding motion of the tamping rod and then trowel finish to obtain a smooth surface.

   Identify the cylinders with a marking pen, or other suitable means, that will not be affected by water or moisture. Do not inscribe numbers or letters on the tops of the cylinders with a sharp instrument. The tops must remain smooth.

VI. CURING CYLINDERS



1. The specimens shall be left at or near their casting positions on a rigid level surface free from vibrations. It is important that they remain level. The cylinders shall then be immediately covered with the white plastic cap supplied with the cylinder mold and allowed to care for approximately 24 hours.

2. Adequate protection shall be provided so that the specimens during the initial cure period, are not subjected to temperatures outside the range 60°F to 80°F.

3. Following the initial 24 hour curing period, the cylinders shall be placed in a water filled curing box that is operating at a curing temperature of 72°F ± 5.0°F. The cylinders shall remain in the curing box undisturbed for a period of 6 to 13 days.

VII. CONCRETE CYLINDER REPORT

For each pair of cylinders cast in the field, a Concrete Cylinder Report, Form BR-300c, shall be prepared. The BR-300c consists of an original and four (4) copies which are self duplicating. Use a ballpoint pen and press hard when filling out the forms to ensure that all copies are legible.

The BR-300c consists of three distinct sections:

1. Field Data
2. Material Data
3. Laboratory Test Data

As a field inspector your responsibility lies with the first two sections only (Field and Material Data).

The BR-300c shown in Figure 1 has been filled out and numbered to show what information is required. Specific instructions are listed below for some of the numbered items that may not be self-explanatory. Additional instructions may also be found on the back of the BR-300c Form. (Figure 2)

1. & 2. Region and Date - Self Explanatory.

3. Circle - Circle box to indicate type of concrete plant.

4. Job Stamp - Stamp each individual copy of the form.

BR 300c (11/82) NYS DOT MATERIALS BUREAU

CONCRETE CYLINDER REPORT

DISTRIBUTION -- LAST COPY TO MATERIALS ENGINEER
ALL OTHERS WITH CYLINDERS

Card 1 → Region (1): 11 | Date (2): Month 05 / Day 23 / Year 84 | Use (3): Circle — Standard 1 | Precast 2

JOB STAMP

D250254 P.I.N. S935.56.301
RECONSTRUCTING THE THIRD AVENUE
BRIDGE
BRONX COUNTY
YONKERS CONTRACTING CO. INC.

(5) Concrete System: Circle Number Corresponding To System — Truck 1 | Truck/Layered 2 | Transit 3 | Central Mix 4 | Mobile Mixer 5 | Other 6

(6) Class Used: Circle — A | B | C | D | E | F | G | H | Other. Specify (if other)

(7) Pay Item: (See Back) 555501

(12) Placement Location: NORTH PEDESTAL

(13) Placement Volume: 012 cu. yds.

(8) Slump: 200 in.

(9) Air Content: 5.4 %

(10) Concrete Temp.: 52 ° F

(11) Air Temp.: 064 ° F

(14) Time Cast: Hr. 11 : Min. 15 | Circle — 1 AM | 2 PM

(15) Cylinder Set: 016

(16) Cylinders: 6 + H

(17) Curing Box No.: 8828

Cylinders were cast for one or more of the following (CIRCLE) (18):

Purpose	Accelerated Strength	Standard Testing	Early Open Sequence			Record Sampling	Other
Age	2 - 4 days	28 days	14 days	21 days	28 days	28 days	
Cylinders	A + B	C + D	E + F	G + H	I + J	K + L	
	1	2		3		4	5

(20) Contract Number: D250254

(21) PIN: 935.56.301

(19) Cast by: D. B COOPER

(22) DOT Line Number: 45542

Remarks (23)

Card 2 →

(24) Plant Name: AIRWAYS

(25) Location: BRONX

(26) Code No.: 00651

(27) Cement Type: Circle — Type 1 | Type 2 | Type 3 | Type 4 | Type 5 | Type 6 | Other

(28) Brand Used: ATLANTIC

(29) Code No. (See Back): 05

Additives -- Circle Not More Than ONE In Each Group

(30) Air Agent: None Used 00 | Darex 01 | MBVR (Conc) 02 | MBVR 03 | Air-X 04 | Air-X (dbl) 15 | Sika AER 16 | Sika (dbl) 17 | Daravair R 18 | Daravair X 19 | Other 05

(31) Brand (if other):

(32) Retarder: None Used 00 | Daratard 01 | Daratard HC 08 | Pozzolith 100R 02 | Pozzolith 100XR 03 | Retardwell 09 | Plastiment 10 | Other 05

(33) Brand (if other):

(34) Water Reducer: None Used 0 | Used 1

(35) Brand (if used):

(36) Fine Agg. Test No.: 82 AF 066

(37) Coarse Agg. Test No.: 83 AR 006

(39) Remarks

(38) Coarse Agg. Test No.:

Card 3 →

FOR LAB USE ONLY

Test Number (6, 8, 10-14)

Date Rec'd.

Time Due

Date Due

Date Tested: Month (15) / Day / Year 20

Capping System: Circle (21) — Neopr. 1 | Sulfur 2

Time Tested: Hrs. 39 : Min. 42 | Circle 44 — 1 AM | 2 PM

Cylinder (22)	Load (Lbs.) (23-28)	Temperature Correction Factor (29-31)	Time Correction Factor (32-34)	Strength (PSI) (35-55)

Age (Days) (56)

Box Temp. (58-60) °F

Tested By

Line Number (61-65)

Remarks

INFORMATION

Information should be printed on the form as neatly as possible and if errors occur, DO NOT ERASE. See EXAMPLES below for details on entering data in shaded boxes, circling items, and error correction.

A. SHADED BOXES

1. Enter only one number in each shaded box.
   EXAMPLE: Date May 8, 1978

Mo.	Day	Yr.
0 5	0 8	7 8

2. Decimals have been printed on the form and it is necessary only to print the numbers in the boxes.
   EXAMPLE: Air Content [0 8 . 0] %

3. Numbers should always be recorded from right to left in the boxes.
   EXAMPLE: A "6" to be entered in these boxes [ ] should be recorded [0 0 6]

4. Slump is recorded to the nearest ¼". The fraction should be recorded as a decimal. .25 for ¼", .50 for ½", .75 for ¾".
   EXAMPLE: Slump [3 . 2 5] in.

5. The Fine Aggregate Test No. and Coarse Aggregate Test No. should be recorded as indicated in the examples below.

   EXAMPLES:

Fine Agg. Test No.	7 1	A F	0 6 2	
Coarse Agg. Test No.	7 1	A G	1 3 2	C

6. If an error occurs, draw a line through the entry in the boxes and record the correct data above the boxes.

   EXAMPLE: 3 0 4 0 / ~~3 0 0 4~~

B. CIRCLED ITEMS

1. If an error occurs in circled item draw a line through the error and circle correct entry.

   EXAMPLE: Water Reducer [None Used (0) | Used ~~(1)~~]

C. PAY ITEM INFORMATION

1. CIRCLE class of concrete actually used. Enter pay item no. called for in contract documents.

   EXAMPLE: Item 555.01, Class A concrete

Class Used	(A)	B	C	D	E	F	G	H	Other

Pay Item			5	5	5 . 0	1		

2. Class H concrete substituted (by option) for Class E concrete under pay item no. 555.0404 (called for)

   EXAMPLE: Item 555.0404, Class H concrete actually used.

Class Used	A	B	C	D	E	F	G	(H)	Other

Pay Item (See Note)			5	5	5 . 0	4	0	4

   Note: First two boxes used ONLY for special specification items.

D. CEMENT BRAND CODE LIST

(Contact Materials Bureau to obtain Code for Brands not listed)

BRAND	MILL OR TERMINAL	CODE	BRAND	MILL OR TERMINAL	CODE
Allentown	Evansville, PA	01	Lehigh	Northampton, PA	44
Atlantic	All	05	Lone Star	Nazareth, PA	18
Bessemer	Bessemer, PA	30	Marquette	All	19
Coplay	Nazareth, PA	21	Medusa	Wampum, PA	28
Dragon	Northampton, PA	07	Medusa	York, PA	40
Federal White	Woodstock, ONT	38	Norcem	Long Island City, NY	39
Glens Falls	Glens Falls, NY	08	Northeast	Oswego, NY	35
Glens Falls	Howes Cave, NY	37	Northeast	Buffalo, NY	46
Hercules	Stockertown, PA	09	Rochester	Rochester, NY	32
Huron	All	11	Rochester	Rome, NY	31
Independent	Buffalo, NY	33	St. Lawrence	Jamesville, NY	45
Independent	Oswego, NY	42	St. Lawrence	Mississauga, ONT	41
Keystone	Bath, PA	12	Whitehall	Cementon, PA	26
Lehigh	Alsen, NY	13	Mixed		27
Lehigh	Cementon, NY	43			

5. Concrete System - Designate type used by circling the appropriate system. If not listed, circle "other" and specify system in remarks -refer to 23.

6. Concrete Class - Circle concrete class actually used, if other than Class A, B, C, D, E, F, G, or H, circle "other" and specify class used in remarks.

7. Pay Item - Enter pay item number called for in contract documents. See back of form.

8., 9., 10. & 11. Slump, Air Content, Concrete Temp. and Air Temp. - Enter the test values conducted at the time the cylinders are cast. Both Concrete and Air temperature shall be recorded regardless of cylinder purpose. Temperature of the concrete shall be taken immediately after remixing the sample and recorded to the nearest whole degree (°F).

12. & 13. Placement Location and Volume - Self-explanatory.

14. Time Cast - Enter time cast regardless of cylinder purpose.

15. & 16. Cylinder Set and Cylinder Designation - Cylinder Set numbers are determined by the Project Engineer. The Inspector or record sampler casting the cylinders will assign each cylinder the proper letter to designate its purpose and age as shown in the following cases:

CASE 1. In this case, the fourth cylinder series tested is being recorded for standard testing, 28 days. Figure 3 below shows how the cylinder set and cylinder letter designation shall be completed.

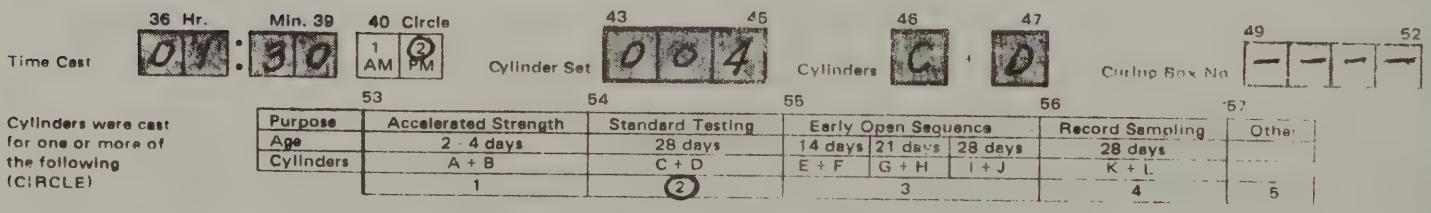


Figure 3

If more than one pair of cylinders are made from one concrete batch, each pair will require its own form, and each pair will be assigned the same cylinder set no., but its own appropriate letter code. The following two cases show typical applications:

CASE 2. In this case, the tenth cylinder series was tested by both the field inspector for standard testing and a record sampler. Both pairs of cylinders would then require their own form and be filled out as shown in Figures 4 and 5.

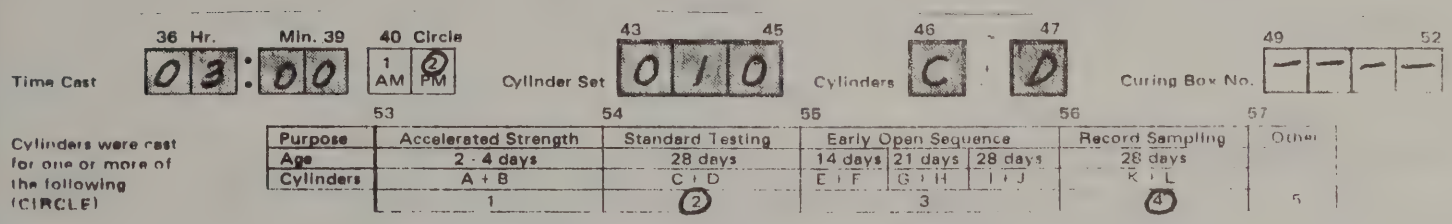


Figure 4. Note - Both C & D and K & L Testing are circled.

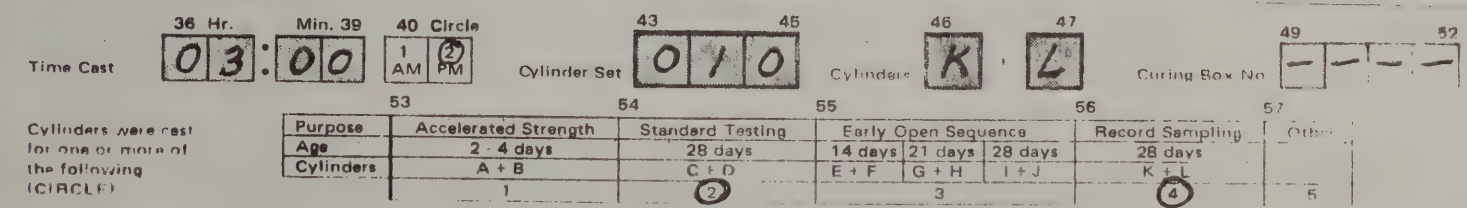


Figure 5. Note - Both C & D and K & L Testing are circled.

CASE 3. In this case, the twentieth cylinder series was tested by the field inspector for Early Open Sequence, which requires three pairs of Cylinders E & F (14 Days,) G & H (21 Days), and I & J (28 Days). Each pair of cylinders requires its own form filled out as shown in Figures 6, 7, and 8.

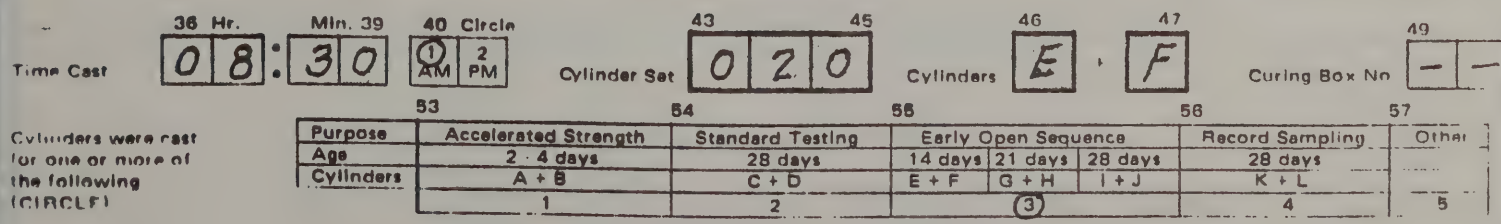


Figure 6

Time Cast — 36 Hr. 0 8 : Min. 39 3 0 — 40 Circle (1) AM / 2 PM — Cylinder Set 43–45: 0 2 0 — Cylinders 46: G + 47: H — Curing Box No. 49: – – –

Cylinders were cast for one or more of the following (CIRCLE)

Purpose	Accelerated Strength (53)	Standard Testing (54)	Early Open Sequence (55)			Record Sampling (56)	Other (57)
Age	2 - 4 days	28 days	14 days	21 days	28 days	28 days	
Cylinders	A + B	C + D	E + F	G + H	I + J	K + L	
	1	2		(3)		4	5

Figure 7

Time Cast — 36 Hr. 0 8 : Min. 39 3 0 — 40 Circle (1) AM / 2 PM — Cylinder Set 43–45: 0 2 0 — Cylinders 46: I + 47: J — Curing Box No. 49: – – –

Cylinders were cast for one or more of the following (CIRCLE)

Purpose	Accelerated Strength (53)	Standard Testing (54)	Early Open Sequence (55)			Record Sampling (56)	Other (57)
Age	2 - 4 days	28 days	14 days	21 days	28 days	28 days	
Cylinders	A + B	C + D	E + F	G + H	I + J	K + L	
	1	2		(3)		4	5

Figure 8

17. Curing Box No. - This pertains to Accelerated Strength testing (Autogenous; 2-4 day breaks). The first digit of the code designates Region, while the last three digits designate the accelerated strength curing box.

NOTE: Procedures for the autogenous curing of concrete cylinders is available upon request from the Main Office Materials Bureau.

18. Cylinder Designation - All cylinders cast from a particular concrete batch shall be noted by circling the appropriate listings. If the fifth listing "Other" is used a letter designation, other than those printed on the form shall be entered. The purpose for these cylinders shall be placed under remarks. (e.g., the twenty-third cylinder series was tested by the field inspector for a 7 Day Break.) This information would be listed on the BR-300c as shown in Figure 9.

Time Cast — 36 Hr. [illegible] : Min. 39 [illegible] — 40 Circle (1) AM / 2 PM — Cylinder Set 43–45: 0 2 3 — Cylinders 46: X + 47: Y — Curing Box No. 49–52: – – – –

Cylinders were cast for one or more of the following (CIRCLE)

Purpose	Accelerated Strength (53)	Standard Testing (54)	Early Open Sequence (55)			Record Sampling (56)	Other (57)
Age	2 - 4 days	28 days	14 days	21 days	28 days	28 days	7 Days
Cylinders	A + B	C + D	E + F	G + H	I + J	K + L	X+Y
	1	2		3		4	(5)

Figure 9. Note - Cylinder age and letter designation are entered, in appropriate locations under "Other."

19. & 20. Self-explanatory.

21. PIN - Enter first six digits of PIN in contract. If a project has more than one PIN number, enter the primary number only.

22. DOT Line Number - Inspector's personal line number.

23. Remarks - Enter any information relevant to cylinders that is not normally shown. (Possible damage to cylinders, mix characteristics such as pump mix, etc.)

24.,25., & 26. Concrete Plant Information - Enter the name, location and code number for the appropriate concrete plant as it appears on the Concrete Plant Summary Listing, which can be obtained from either the plant inspector or the Regional Materials Engineer.

27.,28., & 29. Cement Information - Circle correct cement type used and print the cement brand name. Each cement brand is coded on the back of the form. Enter the correct code in the space provided.

30., 31., 32., 33., 34. & 35. Additives - Circle brand used and make entries as noted.

36., 37., & 38. Fine and Coarse Aggregate Test No. - Enter the fine and coarse aggregate test numbers. This information can be obtained from the Daily Concrete Batch Plant Report (BR-316). If the coarse aggregate consists of a blend, both test numbers shall be entered.

39. Remarks - Enter any information relevant to concrete materials that has not been previously listed on the form.

The Concrete Cylinder Report including all but the last copy shall be shipped with the cylinders to the Materials Bureau Laboratory. The last copy (gold colored) shall be sent to the Regional Materials Engineer for review. The final distribution of the Concrete Cylinder Report BR-300c is as follows:

COPY (Color)		DESTINATION
1.	Yellow	Materials Bureau and EDP
2.	White	Materials Bureau Contract Files
3.& 4.	Green & Pink	Returned to Region
5.	Gold	Regional Materials Engineer

The Project Engineer will receive a copy of the form, through his Regional Office, with the compressive strength results entered at the bottom.

VIII. PACKAGING AND SHIPPING CYLINDERS

At the completion of the field curing period, (7 to 14 days), the cylinders shall be shipped to the Materials Bureau for testing.

The pair of cylinders shall be packed in the cardboard shipping carton with cardboard liner, making sure the plastic cap is on. The Concrete Cylinder Report, Form BR-300c, including all copies except the last copy (gold colored), which is sent to the Regional Materials Engineer, shall be placed in envelope (Form BR-241) and taped at four (4) corners to the inside of the cover of the shipping container. Tape the shipping carton shut with fiber reinforced tape and ship to:

James J. Murphy, Director
Materials Bureau
NYS Department of Transportation
1220 Washington Avenue
Albany, New York 12232

The wire ties, cardboard shipping cartons and liners, and fiber reinforced tape are available through the Regional Materials Engineer.

APPENDIX F

UNIT WEIGHT AND YIELD TEST PROCEDURE

I. SCOPE

This test method prescribes the procedure for determining the weight per cubic foot of freshly mixed concrete, yield and relative yield.

II. GENERAL

There is no required testing frequency for the unit weight or yield, but it is recommended that they be determined initially at the beginning of concrete production and periodically thereafter during the contract to see if the yield requirements of the mix design are being met.

An air content determination should be performed by the pressure meter method (Appendix C) or by the volumetric method if lightweight or porous aggregates are used (Appendix D).

III. SAMPLE

The concrete shall be sampled and remixed in accordance with Appendix A, "CONCRETE SAMPLING PROCEDURES."

IV. EQUIPMENT

1. A container of known volume. The base container of the pressure air meter is suitable as it has a known volume of 0.25 cu. ft. and is large enough to accommodate the maximum size of aggregate normally used in Department mixes. Larger unit weight buckets and large capacity scales are available from the Regional Materials Engineer.

2. A scale of adequate capacity with graduations at least as small as 0.02 pounds.

3. Miscellaneous Equipment - Including a scoop, tamping rod of 5/8" diameter with hemispherical tip, strike-off bar and mallet.

V. TEST PROCEDURE

1. Dampen the inside of the container and then fill it with concrete in the same manner prescribed for the pressure air meter (Appendix C); i.e. three (3) layers of equal depth, rodding each layer 25 times with the tamping rod and rapping the sides of the bowl with the mallet to close the voids.

2. After the third layer has been rodded 25 times and the bowl rapped with the mallet, strike-off excess concrete with the strike-off bar. EXTREME CARE should be taken to insure that the surface is flush with the top of the container. Any error caused by the concrete surface being high or low will be multiplied by 4 when a ¼ cubic foot container is used. Another satisfactory method for the final strike-off is the use of a thick glass plate.

3. Clean the outside of the container of any adhering concrete or mortar.

4. Weigh the concrete filled container to the nearest 0.02 pounds. If a glass plate is used for final strike-off, it should be left in place during the weighing.

VI. COMPUTATIONS

A. Unit Weight

Calculate the weight per cubic foot (unit weight) of concrete as follows:

$$\text{Unit Weight} = W = \frac{W_1 - W_T}{V}$$

Where:

W = Weight of concrete in pounds per cubic foot.

W_1 = Weight of concrete + container + glass plate (if used) in pounds.

W_T = Weight of container + glass plate (if used) in pounds.

V = Volume of container in cubic feet.

Example:

$V = 0.25$ cu. ft. $\quad W_T = 12.74$ lbs. $\quad W_1 = 49.86$ lbs.

Find W:

$$W = \frac{49.86 \text{ lbs.} - 12.74 \text{ lbs.}}{0.25 \text{ ft.}^3} = \frac{37.12 \text{ lbs.}}{0.25 \text{ ft.}^3} = 148.48 \text{ lbs./ft.}^3$$

B. Yield

Determine the volume of concrete (yield) produced as follows:

$$S = \frac{W_C + W_S + W_A + W_W}{W}$$

Where:

W_C = Recorded batch weight of cement in pounds.

W_S = Recorded batch weight of sand in pounds.

W_A = Recorded batch weight of coarse aggregate in pounds.

W_W = Total weight of mixing water added to batch in pounds (1 gallon = 8.345 lbs.)

S = Actual volume of concrete produced (in cubic feet).

W = Measured unit weight of concrete, in pounds per cubic foot.

Example:

Find S

W = 148.48 lbs./ft.^{3} from previous wt. determination.

W_C = 4210 lbs. = recorded batch weight of cement.

W_S = 8640 lbs. = recorded batch weight of sand.

W_A = 16,690 lbs. = recorded batch weight of #1, #2, & #3 stone.

W_W = 2080 lbs. = weight of mixing water added to batch. For truck mixers and paving mixers, convert gage or meter readings to pounds. Central mix plants record the water added in pounds or in gallons.

$$S = \frac{16{,}690\ \# + 8640\ \# + 4210\ \# + 2080\ \#}{148.48\ \#/ft.^3} = 212.96 \text{ cu. ft.}$$

C. Relative Yield

Relative yield is the ratio of actual volume of concrete produced to the volume as designed for the batch. It may be expressed in percent and shall be calculated as follows:

$$Y = \frac{S}{27V_d}\ (100)$$

Where:

Y = Relative yield expressed in percent.

S = Actual volume (yield) of concrete produced in cubic feet.

V_d = Volume of concrete which the batch was designed to produce in cubic yards.

Example:

Find Y

S = 212.96 cubic feet of concrete produced (yield).

V_d = 8 cubic yards

$$Y = \frac{212.96}{27\ (8)}\ (100) = 98.6\%$$

A fluctuation of ± 2 percent in relative yield is considered normal. If a greater fluctuation occurs, a retest should be conducted and the reason for the fluctuation determined.

APPENDIX G

UNIFORMITY TEST PROCEDURE

I. SCOPE

This appendix prescribes the procedure to be followed for conducting a concrete uniformity test. The uniformity test is also known as a mixer efficiency test.

II. GENERAL

This test is used to determine the ability of a mixer, conveyance system or hauling unit to mix or deliver uniform concrete. Samples of plastic concrete are taken from points near the beginning and near the end of discharge from a mixer, conveyance system or haul unit and a series of tests are conducted on each sample. These tests are slump, air content, air free unit weight of concrete, mortar distribution and coarse aggregate distribution. The results of the tests on the "front" and "back" samples are compared and if the concrete is uniform, the results will be similar within certain prescribed limits. An abbreviated uniformity test can be conducted by testing the front and back samples for slump and air content only.

The uniformity test is used only in instances where it is required by the specifications. Table G-1 prescribes the application of uniformity testing procedures to the various concrete mixing and/or delivery systems.

III. EQUIPMENT

The following equipment is required to conduct a complete uniformity test:

1. Sample and Water Containers
2. Two (2) Slump Cones and Accessories
3. Two (2) Air Meters and Accessories
4. Washout Sieve, ¼" or No. 4
5. Scale, 100 lb., capacity.

IV. SAMPLE

Individual samples shall be taken after discharge of approximately 15 percent and 85 percent of the load. Due to the difficulty of determining the actual quantity of concrete discharged, the intent is to provide two (2) samples that are representative of widely separated portions, but not the beginning and end of the load.

The samples shall be obtained directly from the discharge of mixers and hauling equipment prior to any subsequent transportation, spreading or vibration operations.

TABLE G-1

UNIFORMITY TEST APPLICATION

TYPE:	CENTRAL MIXERS	TRANSIT AND TRUCK MIXERS	HAUL UNITS AND CONVEYANCE UNITS
PURPOSE:	Establish minimum mixing times.	Check uniformity.	Check uniformity of delivery.
WHEN REQUIRED:	When there is a request to reduce mixing time.	When ordered by the Engineer. Conduct tests only when routine tests frequently fail or uniformity is detected visually.	Same as Truck Mixers.
TEST SERIES:	1) Slump 2) Air 3) Unit Wt.(Air-Free) 4) Coarse Agg. Content 5) Air-Free Mortar	Same as for Central Mixers except that an abbreviated test series may be substituted as follows: 1) Slump 2) Air	Same as Truck Mixers.
CRITERIA:	Seven series of tests are conducted for a given mixing time. Six series must meet four specified criteria to obtain approval.	One or more series of tests is conducted for the mixer in question. If a mixer fails to meet specified criteria the unit shall not be used until satisfactorily corrective action has been taken.	Same as Truck Mixers.

Each sample shall be large enough to perform separately a slump test and an air test.

V. TEST PROCEDURE

The following procedure shall be followed when conducting a complete uniformity test:

STEP	TEST REFERENCE
1. Obtain front and back samples.	
2. Conduct slump test on each sample.	Appendix B
3. Fill base of air meter and weigh in air for each sample.	Appendix F
4. Conduct air tests on samples weighed in Step 3.	Appendix C
5. Transfer concrete in air meter base to washout sieve for each sample.	
6. Remove all mortar from each sample by washing the concrete on the sieve in water.	
7. Weigh the washout sieve containing the coarse aggregate submerged in water. This is accomplished by hanging the sieve from the scale by wires or rods. The entire sieve and its sample must be submerged.	

VI. COMPUTATIONS

A. Test Data

The following example is used to illustrate the data obtained from field tests:

	FRONT SAMPLE	BACK SAMPLE
1. Slump	2"	2½"
2. Air	7.0%	6.5%
3. Wt. Concrete & Base (in Air)	44.14 lbs.	44.65 lbs.
4. Wt. Coarse Aggregate and Weight of Sieve (in Water)	16.14 lbs.	16.87 lbs.

The following additional data is required for the calculations:

1. Volume Air Meter Base - 0.25 cubic feet
2. Wt., Air Meter Base (in Air) - 7.91 lbs.
3. Specific Gravity, Coarse Aggregate - 2.70
4. Wt., Washout Sieve (in Water) - 4.00

B. Unit Weight - Air Free Basis

The following example is used to illustrate the calculations performed to determine the variation in the air-free unit weight of concrete:

1. Unit Weight -

$$U = \frac{b}{v\left(1 - \frac{A}{100}\right)}$$

Where:

U = Unit weight concrete air-free basis.

b = Weight of concrete sample in air meter base. This is equal to the weight of the concrete and base minus the weight of the base.

v = Volume of air meter base, cubic feet.

A = Air content of sample, percent.

Using the example data:

Front Sample:

$$U_F = \frac{44.14 - 7.91}{0.25\left(1 - \frac{7.0}{100}\right)} = 155.83 \text{ lbs./ft.}^3$$

Back Sample:

$$U_B = \frac{44.65 - 7.91}{0.25\left(1 - \frac{6.5}{100}\right)} = 157.18 \text{ lbs./ft.}^3$$

2. Variation -

Variation = $(U_F - U_B)$ or $(U_B - U_F)$

Using the example data:

Variation = 157.18 - 155.83 = 1.35 lbs./ft.^{3}

C. Coarse Aggregate Variation

The following example is used to illustrate the calculations performed to determine the percent variation in coarse aggregate:

1. % Coarse Aggregate -

$$P = \frac{c}{b} \times 100$$

Where:

P = % coarse aggregate by weight in concrete.

b = Weight of concrete sample in air meter base. This is equal to the weight of the concrete and base minus the weight of the base.

c = Saturated-surface-dry (SSD) weight of aggregate retained on sieve. This can be determined in the following manner:

$$c = \frac{(\text{Wt. Sieve \& Agg. in Water} - \text{Wt. Sieve in Water})\ (G)}{(G-1)}$$

Where:

G = Specific Gravity, Coarse Aggregate.

Using the example data:

Front Sample:

$$b = 44.14 - 7.91 = 36.23$$

$$c = \frac{(16.14 - 4.00)\ (2.70)}{(2.70 - 1)} = 19.28 \text{ lbs.}$$

$$P_F = \frac{19.28}{36.23} \times 100 = 53.22\%$$

Back Sample:

$$b = 44.65 - 7.91 = 36.74$$

$$c = \frac{(16.87 - 4.00)\ (2.70)}{(2.70 - 1)} = 20.44 \text{ lbs.}$$

$$P_B = \frac{20.44}{36.74} \times 100 = 55.63\%$$

2. Variation -

Variation in % Coarse Aggregate = $(P_F - P_B)$ or $(P_B - P_F)$

Using the example data:

Variations in % Coarse Aggregate = 55.63% - 53.22% = 2.41%

D. Air Free Mortar Variation

The following example is used to illustrate the calculations performed to determine the percent variation in the air free mortar:

1. Unit Weight Air Free Mortar -

$$M = \frac{b - c}{V - \left(\frac{V \times A}{100} + \frac{c}{G \times 62.4}\right)}$$

Where:

M = Unit Weight air free mortar, lbs. per cu. ft.

b = Weight of concrete sample in air meter base. This is equal to the weight of the concrete and base minus the weight of the base.

c = Saturated-surface-dry (SSD) weight of aggregate retained on sieve.

G = Specific Gravity, Coarse Aggregate.

V = Volume of air meter base, cubic feet.

A = Air content of sample, percent.

Using the example data:

Front Sample:

b = 36.23

c = 19.28

G = 2.70

V = 0.25 $ft.^3$

A = 7.0%

$$M_F = \frac{36.23 - 19.28}{0.25 - \frac{(0.25)(7.0)}{100} + \frac{19.28}{(2.70)(62.4)}} = 143.52 \text{ lbs./ft.}^3$$

Back Sample:

b = 36.74

c = 20.44

G = 2.70

V = 0.25 ft.^{3}

A = 6.5%

$$M_B = \frac{36.74 - 20.44}{0.25 - \frac{(0.25)(6.5)}{100} + \frac{20.44}{(2.70)(62.4)}} = 144.89 \text{ lbs./ft.}^3$$

2. % Variation -

$$\% \text{ Variation in Air Free Mortar} = \frac{M_F - M_B}{\frac{M_F + M_B}{2}} \times 100$$

Using the example data:

$$\% \text{ Variation} = \frac{(144.89 - 143.52)}{\frac{(144.89 + 143.52)}{2}} \times 100 = 0.95\%$$

VII. DATA SUMMARY AND CRITERIA

Upon completion of testing, the data is summarized and compared to the "uniformity criteria." The following is an example of a data summarization for a "complete" uniformity test. The example criteria shown is from the 1981 Specifications which applied to central mixers, haul units, and conveyance systems. Job specifications should be consulted for the proper criteria to be utilized.

UNIFORMITY TEST DATA SUMMARY

Test	Permissible Variation (Concrete Samples taken at two locations in the batch)
1. Weight per cubic foot calculated to an Air-Free Basis	2.0 lbs. per C.F.
2. Air Content, % by volume of concrete	1.0 percent
3. Slump:	
Average slump 4 inches or less	1.0 inches
Average slump greater than 4 inches	1.5 inches
4. Coarse aggregate content, portion by weight of each sample retained on a No. 4 sieve.	6.0 percent
5. Unit weight of air-free mortars based on average for all comparative samples tested.	1.6 percent

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